CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER NO.91-104

SITE CLEANUP REQUIREMENTS AND RESCISSION OF ORDER NO. 89-058 FOR:

SIGNETICS, INC.

FOR THE PROPERTY AT: **811 EAST ARQUES AVENUE**
SUNNYVALE
SANTA CLARA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter called the Board) finds that:

1. Location and Facility Description Signetics owns and operates a facility located at 811 East Arques Avenue, in Sunnyvale, in an area bounded by Fairoaks and the Bayshore (U.S. 101), Central and Lawrence Expressways (see Figure 1). This is an area of Santa Clara County developed as an industrial park, dominated by low rise buildings. The major business activity of the area is semiconductor manufacture and research and development.

   This is an area of low topographic relief in the southern portion of the Santa Clara Valley. Surface drainage in the area is to the north, toward San Francisco Bay. Vegetation is limited to grass and shrubs.

2. Site History Signetics has operated a semiconductor manufacturing facility at the 811 E. Arques Avenue since 1964. The manufacturing processes employed at this location have utilized various organic solvents, acids, corrosives, and metals. Current chemical usage is similar to past patterns, with the exception of the closure of the plating operation at 811 E. Arques, which has eliminated some potential sources of metal pollution, and the elimination of chemicals containing chromium, phenol, trichloroethylene (TCE), and perchloroethylene (PCE).

   Initial investigation at the site began in February 1982 with the detection of a leak in an underground waste solvent storage tank. The presence of contaminated soil was verified during the tank removal. Following additional investigation of the Signetics main campus facility (440 Wolfe, 815 Arques, 830 Arques) the waste solvent tank area has been identified as the principal source of contaminants on the Signetics site.

   All storage and treatment facilities have been updated and either relocated above ground or doubly contained. Hazardous materials from other nearby Signetics facilities are stored at the 811 E. Arques site, under the regulation of the Federal Resource Conservation and Recovery Act (RCRA), prior to offsite disposal at an appropriate commercial disposal facility.

   Pursuant to the South Bay Multi-Site Cooperative Agreement (MSCA) and the South Bay Ground Water Contamination Enforcement Agreement,

entered into on May 2, 1985 (as subsequently amended) by the Regional Board, EPA and DHS, the Regional Board has been acting as the lead regulatory agency. The Regional Board will continue to regulate the discharger's remediation and administer enforcement actions in accordance with CERCLA as amended by SARA.

The site had been proposed for inclusion on the National Priorities List (NPL) and has been regulated by Regional Board Orders, as indicated herein:

a.	April 16, 1983	Waste Discharge Requirements Adopted
b.	October 1984	Site proposed for inclusion on the National Priorities List (NPL)
c.	September 18, 1985	Waste Discharge Requirements Adopted
d.	December 16, 1987	Site Cleanup Requirements Adopted
e.	July 20, 1988	Waste Discharge Requirements Adopted
f.	April 1989	Revised Site Cleanup Requirements Adopted.
g.	July 19, 1989	Waste Discharge Requirements Amended.
h.	October 4, 1989	EPA drops proposal to include Signetics on the NPL

3. Scope and Role of Operable Unit Within Site Strategy For purposes of these reports and the proposed final remedial action plan a study area study area has been divided into four operable units (OU). These operable units include AMD 901/902, Signetics Main Campus (811 East Arques and neighboring Signetics' facilities), the former TRW Microwave facility (825 Stewart Drive) and an offsite area of commingled plumes north of Duane Avenue extending about 500 feet north of the Bayshore Freeway (Highway 101) and the Westinghouse facility south of Duane Avenue (see Appendix 1, Figure 2). The plumes have become commingled in the subsurface and the Offsite OU is necessary to include the extent of the groundwater pollution. These dischargers will be referred to collectively in this Tentative Order as "the Companies".

Proposed final Remedial Investigation/Feasibility Study (RI/FS) reports were submitted on behalf of AMD, TRW and Signetics (the Companies) in March 1991. Adoption of this Order will approve the joint RI/FS and a final Remedial Action Plan (RAP) that will encompass cleanup at the four operable units including AMD, Signetics, TRW Microwave and the Offsite area.

The purpose of the current interim actions at the Signetics OU is to prevent additional migration of pollutants from soil into groundwater and to control the migration of polluted groundwater from the OU. The intent of the actions in this Order is to expedite final cleanup of groundwater at this OU and to prevent movement of polluted groundwater from this OU to other OUs and potential vertical migration into aquifers that currently serve as drinking water sources.

The Offsite OU is the largest of the operable units. No known or suspected contaminant source areas are present in the Offsite OU. The purpose of remedial actions in the Offsite OU is to protect the beneficial use of the groundwater and to prevent further migration of contaminated groundwater.

4. Regulatory Status Signetics is hereinafter referred to as a discharger because of the releases of hazardous wastes that have occurred at its site. Signetics has accepted responsibility for cleanup at 811 E. Arques, and is a Responsible Party under Federal Superfund regulations (CERCLA/SARA). The Signetics 811 E. Arques facility was proposed for inclusion on the NPL in June 1988. EPA rescinded this action in September 1990 because the site is currently under RCRA regulation. Signetics has been regulated as a Superfund site proposed for inclusion on the National Priorities List (NPL). Signetics will continue to be regulated pursuant to Superfund requirements and guidelines. This Order is intended to outline a proposed plan for the final remedial actions at the Signetics and Offsite OU as required by CERCLA/SARA.

   Separate Orders have been adopted for each onsite operable unit (AMD, Signetics and TRW) with joint responsibility for tasks for the Offsite operable unit. This course has been taken due to the commingling of the groundwater plume in the offsite area. Joint Orders were not pursued because the properties were originally proposed as separate sites on the National Priorities List. The Companies are encouraged to submit joint, coordinated reports when feasible. If joint reports are not coordinated and submitted, each company is still individually responsible for the offsite tasks in this Order. EPA is expected to agree with the selected remedy and issue a Record of Decision following adoption by the Board of a final Order approving the RI/FS and a final Remedial Action Plan.

   Pursuant to Health and Safety Code Sections 25356.1 (c) and (d), the discharger is the only identified responsible party associated with the release of pollutants to the subsurface at this location and has accepted responsibility for the cleanup at the Signetics OU. In addition, as described in finding 3 above, the discharger has accepted responsibility for jointly remediating groundwater pollution in the Offsite OU.

5. Remedial Investigation/Feasibility Study and Proposed Final Cleanup Plan The discharger submitted a Draft Final RI Report, February 1, 1991 and Draft Final FS Report January 15, 1991 which satisfies the requirements of Regional Board Order No. 89-058, Site Cleanup Requirements, adopted by the Board April 19, 1989. The FS report

includes a detailed screening of alternatives for soil and groundwater remedial actions and a discussion of the baseline risk assessment completed under contract to the Board.

The technical information contained in the RI/FS and the Proposed Plan Fact Sheet is consistent with the Health and Safety Code requirements for a final Remedial Action Plan (RAP) and the National Contingency Plan requirements for a RI/FS. The RI/FS contains an evaluation of the interim remedial actions, an evaluation of final remedial alternatives, proposed remedial standards, and a recommended final remedial action plan.

6. Hydrogeology The sediments present in the subsurface at the Signetics facility are a series of interbedded sands, silts and clays. These sediments probably represent deposition by fluvial-alluvial systems as they moved from the uplands to the south to empty into the Bay. Consequently the fine materials are dominant with the coarser grained materials frequently restricted to narrow discontinuous bands or channels.

The nomenclature applied to the water bearing units in the study area is representative of the hydrogeology within the Santa Clara Basin. A number of shallow water bearing units are separated from deeper aquifers by a thick persistent aquitard. The shallow units may be subdivided into multiple zones depending upon depth, lithology and lateral persistence. These zones are frequently labeled as A and B zones. The deeper aquifer is commonly referred to as the C aquifer and the clay layer separating the upper and lower water-bearing zones is commonly referred to as the B-C aquitard. The aquitard has been reported to be between 50 and 100 feet thick in Santa Clara Valley.

Groundwater from this basin provides up to 50% of the municipal drinking water for the 1.4 million residents of the Santa Clara Valley. In 1989, groundwater accounted for approximately 128,000 of the 315,000 acre feet of drinking water delivered to Santa Clara Valley Water District customers. This water is produced from the C aquifer.

Five aquifers have been identified in the vicinity of the Signetics site. These aquifers have been designated A through B4, with A being the shallowest and B4 the deepest. The approximate depth below ground surface at which these units occur at the Signetics OU is as follows: A - 10 to 28 feet: B1 - 28 to 50 feet: B2 - 50 to 70 feet: B3 - 70 to 90 feet: B4 - 90 to 110 feet. The actual thickness and number of potential water bearing units varies across the site and the characteristics of any zone is also variable.

In static conditions the groundwater flow is generally from south to north beneath the 811 E. Arques site. Water levels under static conditions are usually higher in the B zone aquifers than in the A zone, indicating a potential upward vertical gradient. The horizontal groundwater gradient has been reversed in areas of groundwater extraction and the vertical gradient between these two aquifers has been reversed across a broad area by several

extraction wells including those at the 811 E. Arques site and the 815 Stewart Avenue facility.

The extraction rate for B2 and B3 zone extraction wells was increased in 1990 due to evidence of increased migration of contaminants into the deeper B zone units. Not enough data has been collected, due to the short time of operation, to complete an evaluation of the effect of this increased withdrawal on the vertical hydraulic gradient and contaminant migration.

7. State Board Resolution 88-63 On March 30, 1989, the Regional Board incorporated the State Board Policy of "Sources of Drinking Water" into the Basin Plan. The policy provides for a Municipal and Domestic Supply designation for all waters of the State with some exceptions. Groundwaters of the State are considered to be suitable or potentially suitable for municipal or domestic supply with the exception of: 1) the total dissolved solids in the groundwater exceed 3000 mg/L, and 2) the water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day. Based on data submitted by Signetics, the Board finds that neither of these two exceptions apply to the A and B zones at Signetics or the Offsite OUs. Thus, the A and B zones are considered to be potential sources of drinking water.

8. Source Investigation Following the discovery of the leak in the waste solvent tank west of the 811 E. Arques building a systematic review of potential source areas was completed. Five possible source areas were investigated in detail and a more wide ranging soil gas survey was completed in an attempt to locate a possible unknown source. The areas investigated include the former underground waste solvent storage tank, the 440 Wolfe facility, Main Campus diesel tanks, Main Campus wastewater neutralization tanks, and the former location of wastewater neutralization tanks north of the 811 Arques facility. In addition a soil gas survey was completed in the vicinity of the 815 Stewart Drive building.

   The results of these investigations have identified two probable source areas of volatile organic chemicals (VOCs) within the Signetics OU, the former underground waste solvent tank area and the former 811 Arques wastewater neutralization tank area (see Appendix 1, Figure 3). Based on the results of these investigations other source areas are not anticipated.

   Initial soil pollution investigations focused on the area near the underground solvent waste storage tank in 1983. Additional soil samples were collected in July of 1983; the samples contained a variety of VOCs including trichloroethylene (TCE), tetrachloroethylene (PCE), and 1,2-dichloroethylene (1,2-DCE). The waste solvent storage tank and some associated soil was removed in 1983. Additional soil removal was completed in 1984. The excavation was expanded to the limits allowed by the proximity of the building. This area was identified as a point source for chemicals that resulted in groundwater pollution.

9. Extent of Pollution Initial investigation of soil pollution began in 1982 following the report of a leak in an underground solvent storage tank. Analyses of soil samples from this initial phase of investigation indicated that onsite soil was polluted with up to 8100 ppb TCE, 16,400 ppb 1-,1-,1-trichloroethane (TCA), 18,100 ppb xylene, and 79,000 ppb butyl acetate.

Soil samples were collected from the base of the excavation at various times in 1982. This follow-up investigation of polluted soil remaining in place after the removal of the solvent storage tank detected a variety of organic solvents. The greatest concentrations detected were for TCE at 63,000 ppb, TCA at 1,700,000 ppb and PCE at 1,000,000 ppb.

The initial tank excavation was utilized as part of a larger excavation for the installation of a new subsurface wastewater treatment plant. Prior to beginning the larger construction excavation a series of borings was installed throughout the planned excavation. The borings extended through the vadose zone into the saturated zone at depths of 18 to 19.5 feet. Several soil "hotspots" were identified. The maximum contamination that was detected was in boring S-54 with 6,700 ppb of TCE, 12,000 ppb of TCA, and 23,000 ppb of PCE. The excavation removed soil into the saturated zone, at a depth of about 20 feet. Based on the analysis of soil samples from the borings this excavation should have removed all vadose zone soil containing VOCs greater than 1 ppm total VOCs. However, based on the absence of verification samples from the construction excavation, additional A zone groundwater monitor wells were installed in 1989 downgradient of the excavation. Low levels of VOCs (19 ppb TCE) have been detected in these wells. These levels are probably not indicative of remaining soil contamination in this area.

Groundwater pollution by VOCs was detected during the initial investigation in 1982. Monitoring has been continuous for selected wells on at least a quarterly basis since 1982. Groundwater pollution has spread through the upper four aquifers. Additional wells were installed in 1989 to provide additional characterization of the extent of vertical pollution.
The highest initial concentrations of TCE detected in the A aquifer was 34,000 µg/l in 1982 in well S049A. The highest concentration of TCE in the A aquifer in the most recent round of sampling (October 1990) was 22,000 µg/l in well S091A with groundwater from well S049A containing 12,000 µg/l TCE. The concentration in well S091A is an historic low for TCE in groundwater from that well.

The highest initial concentration of TCE in the B1 aquifer was 2600 µg/l in 1982 in well S048B1 and 25,000 µg/l in 1983 in well S075B1. Currently the highest concentration of TCE in the B1 aquifer is 20,000 µg/l at well S065B1. The highest concentration of TCE in the B2 aquifer was 13,000 µg/l at well S048B2 in 1986, 20,000 µg/l in 1988, and 8800 µg/l at the same well. The highest initial concentration of TCE in the B3 aquifer was 25,000 µg/l of TCE in well S101B3 in 1986. Currently the highest concentration of TCE in the B3 is 740 µg/l, also measured in well S101B3. The maximum

concentration in October 1990 in an onsite B4 aquifer well at 811 E. Arques was 13 µg/l. This is the first occurrence of a chemical of concern above drinking water standards in an onsite B-4 aquifer well.

The current volume of contaminated groundwater in the A aquifer is estimated to be 1,353,600 cubic feet (10,125,631 gallons) and 10,516,500 cubic feet (78,668,883 gallons) in the B aquifer. This estimate is based on the surface area of the Signetics OU and average saturated thicknesses for the individual aquifer zones.

It was determined in 1984 that groundwater pollution had migrated north, downgradient from the Signetics property. This groundwater pollution plume had become commingled with polluted groundwater emanating from point sources identified at Advanced Micro Devices (AMD) Building 901/902 (AMD901/902) and TRW (FEI) Microwave at 825 E. Stewart Drive.

The current volume of contaminated groundwater in the A aquifer in the Offsite OU is estimated to be 1,490,600 cubic feet (11,145,974 gallons) and 41,140,000 cubic feet (307,748,571 gallons) in the B aquifer. This estimate is based on the surface area of the Offsite OU and average saturated thicknesses for the individual aquifer zones.

Offsite the contamination extends to a depth of up to 100 feet in the B4 zone. The pattern of vertical contamination generally represents the standard model for contaminants that are heavier than water, in that the depth of contamination increases with distance from the source area. The extent of the lateral migration of groundwater pollution from the Signetics OU is difficult to assess due to the commingling of the groundwater plumes. The groundwater contamination does not appear to have had an impact on any special environments or populations.

10. Baseline Public Health Evaluation A Baseline Public Health Evaluation (BPHE) is conducted at every Superfund site to evaluate the risk posed by the site in its existing condition. The BPHE examines the chemicals present at the site and the possible routes of exposure to humans and animals. Once the potential risk or hazard from the site is established, judgments can be made as to which environmental laws and standards are applicable to the situation and what cleanup goals are appropriate.

Chemicals of Concern Using very conservative assumptions regarding concentration, distribution, toxicity, and potential routes of exposure, the BPHE (*Clement, 1990*) identified twenty-eight "chemicals of potential concern" for groundwater. This included sixteen organic chemicals and twelve inorganic chemicals. Further evaluation of the groundwater data in the FS has resulted in the reduction of the number of organic chemicals to ten chemicals of concern and the elimination of all the inorganics. The FS also presents the chemicals of concern by operable unit. The chemicals of concern for the Companies site in the FS are listed in Appendix 2, Table 1.

Exposure Scenarios Using similarly conservative assumptions, the BPHE also developed future and current exposure scenarios. For the hypothetical future exposure scenarios, it was assumed that the onsite areas of the site would be developed for residential use and that the groundwater in the A- and B-aquifers would be used for domestic water supply purposes. The potential current exposure scenario considered in the BPHE evaluated inhalation of VOC vapors originating from the offsite groundwater plume.

According to the BPHE, **potential future exposure** routes at the Companies site may include ingestion of groundwater containing the chemicals of potential concern, inhalation of VOC vapors from groundwater during showering or other domestic uses, and inhalation of VOC vapors originating from the groundwater. Based on the absence of known soil "hot-spots", other than those well below ground surface and beneath buildings, direct contact exposure to chemicals of concern was not considered further in the exposure evaluation.

The only **current exposure identified** in the BPHE is indoor exposure to vapors migrating from the contaminated groundwater in the offsite area. This pathway was evaluated for two separate populations, residents of the offsite area and children attending the San Miguel school. These cancer risks and health hazard assessments are based on estimates of the indoor air concentrations of the chemicals of concern predicted by mathematical models. The predicted carcinogenic risk for the average case is estimated to be about 4 in 100,000,000 for schoolchildren and about 6 in 100,000 for residents. The model does not predict any toxic effects from this exposure. This is within the risk range that would be allowable under EPA guidance after cleanup.

The future use scenarios considered by the BPHE is domestic use of shallow groundwater beneath the site. This would expose residents to contaminated groundwater through ingestion of water and inhalation during domestic use (showering, cooking, etc.). The greatest potential carcinogenic risk related to the average exposure through these pathways is approximately 2 in 1000.

Domestic use is a hypothetical case since shallow groundwater in the A- and B-aquifers is not currently used for water-supply purposes and local ordinances prohibit such practice. Currently, there are no plans to use the A- and B-aquifer groundwater as a drinking water supply. However, it is the intent of the proposed final remedial action plan presented in this Order to protect the beneficial use of this resource as a potential source of drinking water.

The BPHE assumption that there will be no continued cleanup is invalid. Based on the potential risk identified by the BPHE it is appropriate to cleanup the groundwater. The Companies have been cleaning up contaminated groundwater from the site since 1982. It is the intent of this Order and actions taken by the Board and other agencies to provide that these efforts will continue.

11. Chemicals Of Concern The BPHE identified chemicals of concern for the study area based on toxicity and frequency of detection for soil and groundwater data. The presence of these chemicals varies between the OUs and subsets of the chemicals of concern have been developed for each OU (see Table 1). In addition new data on inorganics has been collected since the completion of the BPHE. This data indicates that inorganics are not present in groundwater above naturally occurring levels. Therefore inorganics are no longer considered to be chemicals of concern. Also, the identification of some chemicals of concern for groundwater in the BPHE was based on the mobility of the chemical and its occurrence in soil samples. In the instances where these chemicals have not been detected in groundwater the FS did not include these compounds as chemicals of concern.

    Chemicals of concern identified in the FS for the TRW OU include 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethylene (1,1-DCE), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-dichloroethylene (trans-1,2-DCE), TCE, TCA, vinyl chloride (VC), and Freon 113. The chemicals of concern identified for the Offsite OU include all of the above except DCB and VC. In addition PCE has been identified as a chemical of concern for the offsite area. TCE is the chemical most commonly present and serves as an indicator chemical for the Signetics OU and the other OUs within the study area.

12. Interim Remedial Actions, Onsite Soil Polluted soil has been removed from three separate locations, an underground solvent storage tank located west of the 811 E. Arques building, a waste water neutralization tank area, also north of the 811 E. Arques building, and soil removed during the construction of the extraction trench at Signetics' 440 Wolfe facility. Approximately 4,720 cubic yards of soil was removed from the area of the waste solvent storage tank area in 1983. The volume removed from the wastewater tank area is unknown, however based on analyses of soil from the excavation it appears that all soil above 1 ppm total VOCs was removed from this area. The soil removed from the area of the 440 Wolfe trench is insignificant and does not represent soil removal from a source area.

    In October 1988 a pilot test of soil vapor extraction was initiated north of the 811 Arques building. This was at the request of the Board. Previous soil investigations have not documented a source area for the elevated levels of contaminants detected in wells in this area. Based on the results of this pilot project three additional vapor wells were installed in August 1989. In approximately sixteen months of operation from October 1988 through February 1990 the system removed between 200 and 300 pounds of total VOCs. The variability is a function of the difficulty of measuring low levels of VOCs in air.

    Contaminated soil above the saturated zone is not expected or known in the Offsite OU, therefore no interim remedial actions for soils in the Offsite OU have been proposed or undertaken.

13. Interim Remedial Actions, Onsite Groundwater Signetics operates six separate groundwater extraction systems in the vicinity of 811 E. Arques. In 1982 initial extraction of groundwater in the A aquifer began shortly after the discovery of pollution. This was accomplished with the basement dewatering sumps surrounding the 440 Wolfe Building, downgradient of 811 E. Arques. Similar systems also operate in the northern portion of the 811 Building and the waste water treatment building.

    Three other extraction systems were designed and installed specifically to contain polluted groundwater to the Signetics' property. An extraction trench system was installed in the A aquifer north of 440 Wolfe Road in 1984 and operation began in 1985. Operation of this trench has been continuous with the exception of maintenance. Due to low water levels resulting from the drought and long term groundwater withdrawal the system has been operating cyclically.

    An extraction trench was installed in the A aquifer north of the 811 E. Arques Building in 1984. The intent of this trench was to intercept polluted groundwater that may have come in contact with the polluted soil remaining in place at the 811 site. After an initial period of effective recovery of polluted groundwater this trench became ineffective. This is again an effect of the low water levels resulting from the current drought.

    The third groundwater extraction system consists of a series of six wells north of the Signetics facility at 815 E. Stewart Drive. This system was intended to prevent further migration of polluted groundwater downgradient to the north across the Signetics property boundary. The system consists of three A aquifer wells, one B1 aquifer well, and two B2 aquifer wells. Operation of this system began in 1987 and with the exception of downtime for maintenance operation has been continuous to date. Extraction rates from the B2 aquifer were increased in 1990.

    All extracted groundwater is treated by a common treatment system utilizing air stripping and carbon adsorption on air stripper offgas and as final polish on the water. The treatment system is located at the 440 Wolf Road Building. The treated groundwater is currently 100% reused as industrial process water or for non-potable uses. In the event of temporary plant shutdown the water will be discharged to surface waters following treatment under NPDES Permit Number CA0028720.

14. Interim Remedial Actions, Offsite Groundwater Two offsite groundwater containment extraction systems have been installed. The Duane Avenue Extraction system, consisting of nine extraction wells, is located just south of Duane Avenue, approximately 1200 to 2100 feet downgradient (north) of the AMD, Signetics, and TRW operable units. This extraction system was installed and began operation in 1986. The Duane Avenue system extracts water from the A, B1, B2, B3 and B4 aquifers.

A second extraction system consisting of fourteen wells, along Alvarado Avenue, approximately 2700 to 4300 feet downgradient (north) of the AMD, Signetics and TRW operable units, was completed in 1988. Operation of the Alvarado Avenue system began in October 1988. This system extracts water from the A, B1, and B2 aquifers. Data has been collected for the evaluation of both extraction systems and a report evaluating the effectiveness of the systems was submitted on March 10, 1989.

All offsite extracted groundwater is transferred by a piping system to AMD's 915 DeGuigne facility where the water is treated. About 50 % of the treated water is utilized as process make-up water by the AMD 915 facility and the remainder is released to surface water under NPDES permit number CA0028797.

15. Vertical Conduit Study A well search for abandoned wells in a 3350 acre area encompassing the study area was completed in December 1986. This includes over one mile in all directions and over three miles in the downgradient direction. The focus of the well search was to identify wells that potentially may form migration pathways to the deeper aquifer. The search identified 177 possible well locations. Of these wells 76 are identified as destroyed. Only two of the wells were within the groundwater contamination plume area. Further investigation indicated that one of these wells was a cathodic protection well maintained by PG&E. This type of well is frequently installed to inhibit rust in underground pipelines. These wells are typically shallow (i.e. pipeline depth) and cased with steel. No additional data was available on the other well and attempts to field check the well location were unsuccessful.

Two municipal supply wells were identified by the potential conduit study. Well ID number 1845 is a City of Sunnyvale water supply well. This well is over 3000 feet upgradient of the known groundwater contamination plume. Well ID number T6SR1WS29N2 T6SR1WS29 is also upgradient of the groundwater pollution plume and is shown in Santa Clara Valley Water District records as destroyed.

16. Data Quality Development of the Board's final RAP was based on four criteria: 1) data was collected following an approved sampling and analysis plan, 2) random sample splits were collected by Board staff to confirm the validity of data generated by Signetics 3) Signetics' data was validated by the Department of Health Services and found to be at least qualitatively acceptable, and 4) there has been reasonable repeatability of the data based on seven years of monitoring. Thus the Board finds that there is sufficient acceptable data to make cleanup decisions.

17. Description of Remedial Alternatives Initially, a large number of cleanup methods (technologies) were screened with respect to their effectiveness, implementability, and order-of-magnitude cost. The methods which passed this initial screening were then combined into cleanup alternatives most applicable to each Operable Unit and evaluated in detail. The detailed analysis included an evaluation based on the nine criteria listed below:

Signetics (cont.)

- o Overall protection of human health and the environment
- o Compliance with ARARs
- o Short-term effectiveness
- o Long-term effectiveness
- o Reduction of toxicity, mobility, or volume
- o Implementability
- o Cost
- o State acceptance
- o Community acceptance.

The cleanup alternatives which were so evaluated for Signetics and the Offsite OU are described below. The results of the nine criteria evaluation are presented in Finding 18.

Signetics Operable Unit

Alternatives 1 through 4 combine soil and groundwater remedial alternatives for the OU (see Appendix 2, Table 2).

Alternative 1: No Action In this alternative, no action would be taken to remediate soil or groundwater and the existing soil-vapor vacuum extraction system would be shut down.

Alternative 2: No Additional Groundwater or Vacuum Extraction Alternative 2 comprises the interim remedial system currently in operation. Groundwater is extracted using two extraction trenches, six extraction wells, and three basement dewatering sumps. The existing soil-vapor vacuum extraction system would continue to operate. Extracted groundwater would continue to be treated by air stripping followed by carbon polishing of the effluent water. In addition, vapor-phase carbon would continue to be used to remove residual VOCs from the effluent air stream from the air strippers.

Alternative 3: Enhanced Groundwater Extraction This alternative consists of improving the extraction system to compensate for declining water levels; these declines have resulted in decreases in contaminant removal rates and apparent increases in downgradient VOC concentrations. The existing soil-vapor vacuum extraction system would continue to operate. The proposed improvements to the groundwater extraction system are:

- o Increase pumping rate at the 440 Wolfe extraction trench to decrease the water levels in the trench
- o Install a series of A-aquifer extraction wells north of the 811 Arques Avenue building
- o Install piezometers along and north of the 815 Stewart Drive property boundary to assess the current capture zones
- o Install additional A-aquifer extraction wells immediately north of the 815 Stewart building, unless declining water levels preclude extraction
- o Resume pumping from an existing B1/B2-aquifer extraction well

(S-100B1)

- Initiate groundwater extraction from the B3-aquifer if onsite VOC concentrations increase significantly.

Alternative 4: Enhanced Groundwater (A- and B-Aquifers) and Vacuum Extraction (A-Aquifer) This alternative is similar to Alternative 3 except that both the groundwater and vacuum extraction systems are expanded. The expanded vacuum extraction system would include four additional vapor extraction wells and an upgrade of the blowers and carbon adsorption system.

Offsite Operable Unit

Remedial alternatives for soil were not addressed for the Offsite Operable Unit because contaminant sources in soil are limited to the onsite Operable Units only.

Alternative 1: No Action The no action alternative involves no further action to treat, contain, or remove any of the contaminated groundwater. To implement this alternative, planned and existing remedial measures would be discontinued. Groundwater monitoring would continue. Time for the groundwater to achieve compliance with ARARs is unknown with best estimates in the range of hundreds of years. The present worth cost is projected to be $1,900,000.00.

Alternative 2: Expanded Extraction, Air Stripping, and Carbon Adsorption: This alternative consists of continued operation of the existing offsite extraction and treatment system. The system currently extracts groundwater from 23 extraction wells. The extracted groundwater is conveyed through an underground piping system to the AMD Building 915 treatment facility; the groundwater is treated by air stripping followed by aqueous carbon adsorption. Currently, about 30 percent of the treated groundwater is reused at the AMD facility, with the remainder discharged under an NPDES permit to the storm drain system. The spent carbon is removed and regenerated offsite, as needed, approximately every 1.5 years.

The hydraulic performance evaluation of the extraction system indicated that because of declining water levels, hydraulic capture is not being fully maintained in the A- and B2-aquifers. It is estimated that 5 new A-aquifer extraction wells (or an extraction trench) and 3 new B2-aquifer wells may be needed to maintain adequate capture. Based on results of a simplified model it is estimated that this alternative could meet groundwater ARARs in 36 years. The present worth cost for this alternative is estimated at $4,400,000.00.

Alternative 3: Extraction and Carbon Adsorption This alternative consists of pumping groundwater from the upgraded offsite extraction systems and treatment of the water by carbon adsorption. The treated groundwater would be reused and/or discharged under an NPDES permit to the storm drain system. This alternative differs from Alternative 2 in that VOC removal is accomplished by means of a carbon adsorption unit only, rather than

by use of a combined air stripping/carbon adsorption system. The estimated time to achieve cleanup is 36 years, the same as Alternative 3. The present worth cost for this alternative is estimated at $10,000,000.

18. Evaluation of Final Remedial Alternatives As previously mentioned, the alternatives for each Operable Unit were evaluated using the nine FS criteria. Tables 2 and 3 summarize the results of the evaluation using the first seven criteria; evaluation of community and agency acceptance is deferred until after the public comment period.

Signetics Operable Unit

Proposed Alternative

Alternative 4 - Enhanced Groundwater (A- and B-Aquifers) and Vacuum Extraction (A-Aquifer) is the recommended cleanup measure for the Signetics Operable Unit. This alternative combines soil and groundwater cleanup measures and expands the existing systems. This alternative is protective of human health and the environment, complies with ARARs, is effective in both the long- and short-term, and reduces the toxicity, mobility, and volume of VOCs in the soil and groundwater.

The actual modifications to the system may vary from those proposed here. Additional study of the modifications and the effect on control of contaminant migration and groundwater conservation will be required (see required Tasks and time schedules in the Provisions of this Order). Based on the modifications proposed the current worth cost of the alternative is estimated to be $4,100,000.

Rejected Alternatives

Alternative 1, the no action alternative is included to provide a basis of comparison. Since it would not be protective of human health or the environment and would not meet ARARs no further consideration is given to this alternative.

Alterative 2 would continue the operation of the existing groundwater extraction, soil vapor extraction, and groundwater treatment systems. These systems do not currently provide control of the shallow groundwater contamination plume and consequently will not provide long term effectiveness.

Alternative 3 would enhance groundwater extraction by improving the extraction system to compensate for declining water levels; these declines have resulted in decreases in contaminant removal rates and apparent increases in downgradient VOC concentrations. The existing soil-vapor vacuum extraction system would continue to operate. It is anticipated that these modifications will improve the control of the shallow aquifer thereby decreasing contaminant mobility in the aquifer system.

Alternative 4 would combine the enhanced groundwater extraction (A- and B-Aquifers) with an enhanced vacuum extraction (A-Aquifer) system. The advantage that this system offers is the improved migration control offered by Alternative 3 combined with improved near source control. The elevated levels north of the 811 Arques building can not be attributed to any known source areas, however it is clear from eight years of groundwater monitoring data that groundwater contaminant concentration is not decreasing in this area as predicted. Therefore increased vapor extraction may help control contaminant mobility and improve system efficiency. The disadvantage of Alternative 4 is that the present worth cost of Alternative 4 is approximately $200,000.00 more than Alternative 3.

OFFSITE OPERABLE UNIT

Proposed Alternative

Extraction, Air Stripping, and Carbon Adsorption is the recommended cleanup measure for the Offsite Operable Unit. This alternative provides good protection of human health and the environment, complies with ARARs, is effective in both the long- and short-term, reduces the toxicity, mobility, and volume of VOCs, is currently in operation, and is cost-effective. Upgrading the current extraction/treatment system with additional wells and/or trenches would improve the performance of the system. The current system's performance is in part due to low water levels in the A zone resulting from the drought and groundwater extraction. The actual number, depth, and location of additional extraction wells that will be required to improve system performance will be determined as part of the remedial assessment remedial design (RA/RD) process (see Provision C.4.n., Task 14). Based on results of a simplified model it is estimated that this alternative could meet groundwater ARARs in 36 years. The present worth cost for this alternative is estimated at $4,400,000.

Rejected Alternatives

The other alternatives considered for the Offsite OU were the no action alternative, which would not be protective of human health or the environment, and groundwater extraction with treatment by carbon adsorption. The no action alternative is included only for comparison and no further consideration will be given to this alternative. The only advantage that treatment by carbon adsorption alone as compared to treatment by an air stripper followed by carbon adsorption is the elimination of the release of offgas and the potential for increased permanent destruction of contaminants after removal. The present worth cost for carbon adsorption treatment alone is estimated at $10,000,000, more than twice the estimated cost of air stripping followed by carbon adsorption. This is not considered to be cost effective.

In summary the proposed final cleanup plan would include the following components:

1. Continued groundwater monitoring,

2. Enhancement of the soil vapor extraction system by increasing the number of vapor extraction wells, increased volume of carbon with offsite treatment and disposal of the carbon units,

3. Enhanced groundwater extraction focused on two areas; 1. improved control of contaminant migration laterally in the A zone and, 2. improved control of vertical migration of contaminants from the B1 and B2 zones to B3 and B4 zones. The enhancement may include modification of existing equipment, installation of new wells or trenches and increased rates of groundwater withdrawal from the deeper aquifers. Treatment would continue with a multiple air stripper array with treatment of the stripper offgas from the initial air stripper through vapor phase carbon. Following the treatment through a second set of air strippers the water is treated by aqueous phase carbon. The carbon is regenerated or recycled offsite and 100% of the water is currently reused onsite in industrial or non-potable uses. In the event of plant shutdown the water would be discharged under an NPDES permit, CA0028720.

4. Modification of the Alvarado and Duane Avenue offsite extraction systems and continued groundwater extraction from these modified systems for the Offsite OU. The modification would focus on improving control of the A zone pollutant plume under the current drought conditions. Treatment would continue with the existing system at AMD 915 with air stripping followed by aqueous phase carbon treatment. The carbon is transfered to a licensed facility where it is regenerated by the use of a rotary kiln and reused at the AMD facility. The treated water is either discharged under NPDES permit or reused onsite, and

5. Implementation of institutional constraints for the Signetics OU until cleanup standards are achieved.

19. Cleanup Standards The cleanup standards must meet all applicable or relevant and appropriate requirements (ARARs) and be protective of human health and the environment. There are no ARARs for soil cleanup. However, the chemicals of concern in soil are the same as those in groundwater, predominantly VOCs. The presence of VOCs at high concentrations would present a continued threat to water quality. The Board has proposed a cleanup standard of 1 part per million (ppm) total VOCs for vadose zone soil. As an alternative to this cleanup level the discharger was provided the option of providing a technical demonstration that levels of VOCs greater than 1 ppm could remain in place in the soil without partitioning from soil into groundwater at levels above groundwater cleanup standards. The latter has not been demonstrated for this site.

Cleanup standards for groundwater are shown as shaded in Provision C.3. Table 4 of this Order. The standards for nine of the ten chemicals of concern for the AMD and offsite operable units are the California maximum contaminant levels (MCLs) for drinking water. The exception is 1,2-dichlorobenzene, for which California has not established an MCL. The cleanup standard for 1,2-dichlorobenzene shall be the proposed Federal MCL. Since groundwater cleanup levels are based on MCLs this will meet all ARARs for groundwater cleanup.

An additional concern that is discussed in the FS is the potential contamination of the air at the Signetics OU and the AMD 915 site. The appropriate standards for this consideration are the regulations of the Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 47 which is an ARAR for this facility. The air stripper systems at Signetics and AMD 915 DeGuigne Drive sites are regulated by the BAAQMD. The air stripper offgas from the initial system at Signetics is treated through vapor phase carbon. The air stripper offgas at AMD 915 (offsite extraction system treatment) is not treated. Air emissions from the AMD 915 facility as a whole, including the air stripper, were required to be evaluated by the BAAQMD under AB 2588. This evaluation ranked the AMD 915 complex as a medium priority. Based on this ranking a health risk assessment for air emissions was not required by the BAAQMD. The air emissions from these units do satisfy the ARAR cited above, as regulated by the BAAQMD.

20. Risk Associated With Cleanup Standards The selected remedy is protective of human health and the environment -- as required by Section 121 of CERCLA -- in that pollution in groundwater is treated to at least MCLs and falls within EPA's acceptable carcinogenic risk range and noncarcinogenic hazard index. EPA's acceptable carcinogenic risk range for cleanup standards selected for a site is 10^{-4} to 10^{-6} as an acceptable cleanup level. If the noncarcinogenic hazard index is less than one, EPA considers the combined intake of chemicals unlikely to pose a health risk.

At the Signetics OU the carcinogenic risk at the cleanup standards (for all chemicals listed on Table 4) associated with the potential future use scenario of groundwater ingestion and inhalation of VOCs from groundwater is 4×10^{-5}. In cleaning up TCE, the predominant chemical of concern, to the 5 ppb cleanup standard it is quite likely that the concentrations of other VOCs will be reduced to levels below the 5 ppb range. This risk represents the maximum residual risk that would be probable following cleanup. This estimated risk is based on cleanup to MCLs for all carcinogenic chemicals of concern identified in the FS for the Signetics OU and assumes that all of these chemicals would be present in groundwater extracted for domestic use. It is probable that this is an overestimate of the actual residual risk after cleanup. In addition this risk includes 1,1-DCE which is classified by the EPA as a possible human carcinogen. This classification is currently under review and the California Department of Health Services (DOHS) does not recommend including 1,1-DCE in risk calculations as a carcinogen. If 1,1-DCE is not included as a carcinogen in the calculation of increased cancer risk the estimated residual risk after cleanup associated with the potential future use scenario of groundwater through ingestion and inhalation of VOCs from groundwater in the Signetics OU is 6×10^{-6}.

For the Offsite OU the carcinogenic risk for the four chemicals of concern identified as carcinogens for the Offsite OU (1,1-DCA, 1,1-DCE, PCE, and TCE) associated with the potential future use scenario of groundwater ingestion and inhalation of VOCs from groundwater is 4×10^{-5}. This estimate is based on the exposure that

would be experienced if all four chemicals were present at the concentration required by the cleanup standards. In addition this risk also includes 1,1-DCE with the same caveats as to its use in risk management as above. If, as above, 1,1-DCE is not included in the carcinogen risk calculations, the estimated residual risk after cleanup associated with the potential future use scenario of groundwater through ingestion and inhalation of VOCs from groundwater in the Offsite OU is 3×10^{-6}.

The noncarcinogenic hazard index associated with the cleanup standards at the Signetics OU is 0.80. The noncarcinogenic hazard index associated with the cleanup standards at the Offsite OU is 0.2. The low hazard index at the Offsite OU is a primarily a function of the small number of chemicals of concern identified for the Offsite OU.

The method and assumptions used to obtain the carcinogenic risk and the hazard index associated with the cleanup standards are contained in the BPHE and FS. A number of assumptions have been made in the derivation of these values, many of which are intentional overestimates of exposure and/or toxicity. The actual incidence of cancer is likely to be lower than these estimates and may even be zero. The cleanup standards for the site are protective of human health, have a carcinogenic risk that falls within a range of 10^{-6} to 10^{-4}, and a hazard index of less than one. No environmentally sensitive populations or habitats have been identified within the study area.

21. Uncertainty in Achieving Cleanup Standards The goal of this remedial action is to restore groundwater to its beneficial uses. Based on information obtained during the RI and on a careful analysis of all remedial alternatives, the Board believes that the selected remedy will achieve these levels. However, studies suggest that groundwater extraction and treatment will not be, in all cases, completely successful in reducing contaminants to health-based levels in the aquifer zones. The Board recognizes that operation of the selected extraction and treatment system may demonstrate the technical impracticability of reaching health-based groundwater quality standards using this approach. If it becomes apparent, during implementation or operation of the system, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation standard, that standard and the remedy may be reevaluated.

The selected remedy will include groundwater extraction for a period of up to 24 years at the Signetics OU and up to 36 years in the offsite area, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation.

Modifications may include:

a) discontinuing operation of extraction wells in areas where cleanup standards have been attained;

b) alternating pumping at wells to eliminate stagnation points; and

c) pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater.

The projected times to achieve cleanup included in this Order are developed in the FS. These times are derived from a simple groundwater model and are intended to provide a basis of comparison for the screening of alternatives. It is probable that these models provide an underestimate of the time required to achieve the cleanup standards proposed in this Order.

22. Future Changes to Cleanup Levels If new information indicates cleanup standards cannot be attained or can reasonably be surpassed, the Regional Board will decide if further final cleanup actions beyond those completed shall be implemented at this site. If changes to the cleanup standards or amended cleanup standards are proposed, due to the claimed technical infeasibility of attaining the standards, adopted by this Order, a new Order will be submitted to the Board for consideration and to EPA Region IX for their concurrence. If changes in health criteria, administrative requirements, site conditions, or remediation efficiency occur, the discharger will submit an evaluation of the effects of these changes on cleanup levels as specified under Provisions C.4.k. and C.4.s.

The Regional Board will not require the discharger to undertake additional remedial actions with respect to the matters previously described herein unless: (1) conditions on the site, previously unknown to the Regional Board, are discovered after adoption of this Order, or (2) new information is received by the Regional Board, in whole or in part after the date of this Order, and these previously unknown conditions or this new information indicates that the remedial actions required in this Order may not be protective of public health and the environment. The Regional Board will also consider technical practicality, cost effectiveness, State Board Resolution No. 68-16 and other factors evaluated by the Regional Board in issuing this Order in determining whether such additional remedial actions are appropriate and necessary.

23. Community Involvement An aggressive Community Relations program has been ongoing for all Santa Clara Valley Superfund sites, including Signetics. The Board published a notice in the San Jose Mercury News on March 13,20, and 27, 1991, announcing the proposed final cleanup plan and opportunity for public comment at the Board Hearing of March 20, 1991 in Oakland, and announcing the opportunity for public comment at an evening public meeting held at the Westinghouse Auditorium, Britton at East Duane Avenue, in the City of Sunnyvale on Thursday March 28, 1991. Public comment was received during an extended 60 day period (at community request) from March 20 through May 20, 1991.

Fact Sheets were mailed to interested residents, local government

officials, and media representatives. Fact Sheet 1, mailed in december 1989, summarized the pollution problem, the results of investigations to date, and the interim remedial actions. Fact Sheet 2, mailed in March 1991, described the cleanup alternatives evaluated, explained the proposed final RAP, announced opportunities for public comment at the Board Hearing of March 20, 1991 in Oakland and the Public Meeting of March 28, 1991 in Sunnyvale and described the availability of further information at the Information Repository at the City of Sunnyvale Library and the Regional Board offices. Written comments received from the community meeting of March 28, 1991, and at an informal meeting held on May 7, 1991 are reviewed in the Responsiveness Summary included as Appendix 3.

24. State Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California" On October 28, 1968, the State Water Resources Control Board adopted Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California". This policy calls for maintaining the existing high quality of State waters unless it is demonstrated that any change would be consistent with the maximum public benefit and not unreasonably affect beneficial uses. The original discharge of waste to the groundwater at these sites was in violation of this policy; therefore, the groundwater quality needs to be restored to its original quality to the extent reasonable. For the purpose of establishing cleanup objectives, the shallow groundwater at the site is designated a potential source of drinking water (see Finding 7).

    The FS evaluated groundwater cleanup to background or non-detect levels. Cleanup to non-detect levels would increase estimated groundwater cleanup times by between 33% and 50% and add significantly to cost. In addition, cleanup of groundwater to below the MCL for the chemicals of concern may not be achievable due to the technical difficulties in restoring aquifers by the removal of low concentrations of any VOC. This is due to the slow desorption of VOCs adsorbed to the inner pore spaces of soil particles which make up the aquifer material and VOCs adsorbed to clays and organic matter in the aquitard. Cleanup to MCL levels would protect the primary beneficial use of the groundwater as a potential source of drinking water. For these reasons, MCLs were accepted as concentrations that meet the intent of Resolution No. 68-16.

    The proposed remedial water quality standards meet current applicable health criteria and restore the quality of the groundwater to the extent reasonable given technical and economic constraints. These constraints include the high additional incremental costs for removal of small amounts of additional chemicals and the need to minimize the removal of groundwater to achieve acceptable remedial standards.

25. Groundwater Conservation AMD has considered the feasibility of reclamation, reuse, or discharge to a publicly owned treatment works (POTW) of extracted groundwater from AMD 901/902, as specified in Board Resolution No. 88-160. Onsite industrial use

accounts for approximately 50% reuse of the water after treatment. The remaining 50% of the treated water is discharged to the sanitary sewer.

The extracted groundwater from the offsite system is piped to AMD 915 for treatment. Reuse at the AMD 915 facility, which includes water from an onsite remedial groundwater extraction system, currently is at about 50% of the total volume. It is anticipated that this will reach 80% during 1991 with an eventual goal of 100% reuse.

26. Basin Plan The Board adopted a revised Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) on December 17, 1986. The Basin Plan contains water quality objectives and beneficial uses for South San Francisco Bay and contiguous surface and ground waters.

27. Beneficial Use The existing and potential beneficial uses of the groundwater underlying and adjacent to the facility include:

    a. Industrial process water supply
    b. Industrial service water supply
    c. Municipal and Domestic water supply
    d. Agricultural water supply

28. The discharger has caused or permitted, and threatens to cause or permit waste to be discharged or deposited where it is or probably will be discharged to waters of the State and creates or threatens to create a condition of pollution or nuisance.

29. This action is an order to enforce the laws and regulations administered by the Board. This action is categorically exempt from the provisions of the CEQA pursuant to Section 15321 of the Resources Agency Guidelines.

30. Onsite and offsite interim containment and cleanup measures need to be continued to alleviate the threat to the environment posed by the continued migration of pollutants and to provide a substantive technical basis for designing and evaluating the effectiveness of final cleanup alternatives.

31. The Board has notified the discharger and interested agencies and persons of its intent under California Water Code Section 13304 to prescribe Site Cleanup Requirements for the discharge and has provided them with the opportunity for a public hearing and an opportunity to submit their written views and recommendations.

32. The Board, in a public meeting on June 19,1991, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED, pursuant to Section 13304 of the California Water Code, that the discharger, its agents, successors, and assigns, shall cleanup and abate the effects described in the above findings as follows:

A. **PROHIBITIONS**

1. The discharge of wastes or hazardous materials in a manner which will degrade water quality or adversely affect the beneficial uses of the waters of the State is prohibited.

2. Further significant migration of pollutants through subsurface transport to waters of the State is prohibited.

3. Activities associated with the subsurface investigation and cleanup which will cause significant adverse migration of pollutants are prohibited.

B. **SPECIFICATIONS**

1. The storage, handling, treatment or disposal of soil or groundwater containing pollutants shall not create a nuisance as defined in Section 13050(m) of the California Water Code.

2. The discharger shall conduct monitoring activities as outlined in the amended sampling plan, approved by the Executive Officer, to define the current local hydrogeologic conditions, and the lateral and vertical extent of soil and groundwater pollution. Should monitoring results show evidence of pollutant migration, additional characterization of pollutant extent may be required.

3. Pursuant to Water Code Section 13304(c), the dischargers are hereby notified that the Board is entitled to and may seek reimbursement for all reasonable staff oversight costs incurred relating to cleanup of waste on this site, abating the effects thereof, or taking other remedial action.

C. **PROVISIONS**

1. The discharger shall submit to the Board acceptable monitoring program reports containing results of work performed according to a program as described in the October 1897 sampling plan, amended 1989, and as further amended and approved by the Executive Officer.

2. All wells in the Signetics and Offsite operable units shall be used to determine if cleanup standards have been met.

3. Final cleanup standards for all onsite and offsite wells shall be not greater than the levels as provided in Finding 19 and as shown in Appendix 2, Table 4.

4. The discharger shall comply with the Prohibitions and Specifications above immediately upon adoption of this Order. In addition, the discharger will perform the following tasks to implement the Final Remedial Action Plan adopted by this Board in accordance with the following time schedule and tasks:

TASK/COMPLETION DATE

SIGNETICS OPERABLE UNIT

a. TASK 1: PROPOSED CONSTRAINTS. Submit a technical report acceptable to the Executive Officer documenting procedures to be implemented by the dischargers, including a deed restriction prohibiting the use of the upper aquifer groundwater as a source of drinking water, and for controlling onsite activities that could endanger the public health or the environment due to exposure to VOCs. Constraints shall remain in effect until groundwater cleanup standards have been achieved and pollutant levels have stabilized in onsite aquifers.

COMPLETION DATE: July 28, 1991

b. TASK 2: CONSTRAINTS IMPLEMENTED: Submit a technical report acceptable to the Executive Officer documenting that the proposed and approved constraints have been implemented.

COMPLETION DATE: 60 days after Executive Officer approval of Task 1.

c. TASK 3: REMEDIAL SYSTEM MODIFICATION: Submit a technical report acceptable to the Executive Officer describing the modifications to the soil vapor and groundwater extraction systems at Signetics including a proposed implementation schedule, location for additional vapor extraction points, additional extraction well(s) or trench(s), monitoring of system operation, and location and description of carbon disposal or regeneration.

COMPLETION DATE: September 15, 1991

d. UPDATING ADMINISTRATIVE RECORD

1) TASK 4: PROPOSED UPDATE. Submit a technical report acceptable to the Executive Officer containing an updated index for the Administrative Record for the period November 1, 1990 through September 30, 1991.

COMPLETION DATE: October 15, 1991

2) TASK 5: UPDATE ADMINISTRATIVE RECORD. Submit a technical report acceptable to the Executive Officer containing the updated Administrative Record documents for the period November 1, 1990 through September 30, 1991.

COMPLETION DATE: December 1, 1991

e. TASK 6: IMPLEMENTATION OF REMEDIAL SYSTEM MODIFICATION:

Submit a technical report acceptable to the Executive Officer documenting the completion of modifications to the soil vapor and groundwater extraction systems at Signetics as approved under Task 3, above, including a proposed well logs, geologic description of excavations, appropriately scaled location maps, any preliminary operational data, and engineering drawings of modified systems as completed.

COMPLETION DATE: September 15, 1992

f. TASK 7: PROPOSAL TO CURTAIL OPERATION OF THE SOIL CLEANUP SYSTEM: Submit a technical report acceptable to the Executive Officer and the EPA containing a proposal for terminating operation of the soil remediation system and criteria used to justify this action. This report shall include a proposal indicating the locations of borings and sampling intervals to determine concentrations of VOCs remaining in the soil.

COMPLETION DATE: 30 days prior to expected termination of soil cleanup

g. TASK 8: CURTAILMENT OF SOIL REMEDIATION: Document in the appropriate quarterly report the completion of the necessary tasks identified in the technical report submitted for Task 6 including the results of chemical analyses of samples from the soil borings.

COMPLETION DATE: Due date for quarterly status report for the quarter in which operation of the soil remediation system is terminated.

h. TASK 9: ONSITE WELL PUMPING CURTAILMENT CRITERIA AND PROPOSAL:Submit a technical report acceptable to the Executive Officer containing a proposal for curtailing pumping from onsite groundwater extraction well(s) and trench(s) and the criteria used to justify such curtailment. This report shall include data to show that cleanup standards for all VOCs have been achieved and have stabilized or are stabilizing, and that the potential for pollutant levels rising above cleanup standards is minimal. This report shall also include an evaluation of the potential for pollutants to migrate downwards to the C aquifer at this location. If the discharger claims that it is not technically feasible to achieve cleanup standards, the report shall evaluate the alternate standards that can be achieved. Cessation of pumping will require the concurrence of the Regional Board and EPA, should either party not concur, continued pumping will be required.

COMPLETION DATE: 90 days prior to proposed

implementation of onsite groundwater extraction curtailment

i. TASK 10: IMPLEMENTATION OF ONSITE CURTAILMENT: Submit a technical report acceptable to the Executive Officer documenting completion of the necessary tasks identified in the technical report submitted for Task 8.

COMPLETION DATE; 30 days after the Regional Board approves onsite curtailment

j. TASK 11: FIVE-YEAR STATUS REPORT AND EFFECTIVENESS EVALUATION: Submit a technical report acceptable to the Executive Officer containing the results of any additional investigation including the soil remediation study; an evaluation of the effectiveness of installed final cleanup measures and cleanup costs; additional recommended measures to achieve final cleanup objectives and standards, if necessary; a comparison of previous expected costs with the costs incurred and projected costs necessary to achieve cleanup objectives and standards; and the tasks and time schedule necessary to implement any additional final cleanup measures.

This report shall also describe the reuse of extracted groundwater, evaluate and document the cleanup of polluted groundwater, and evaluate and document the removal and/or cleanup of polluted soil. If safe drinking water levels, through the removal of the chemicals for which this Order specifies cleanup standards, have not been achieved onsite and are not expected to be achieved through continued groundwater extraction and/or soil remediation, this report shall also contain an evaluation addressing whether it is technically feasible to achieve drinking-water quality onsite, and if so, a proposal for procedures to do so.

COMPLETION DATE: June 19, 1996

k. TASK 12: EVALUATION OF NEW HEALTH CRITERIA: Submit a technical report acceptable to the Executive Officer which contains an evaluation of how the final plan and cleanup standards would be affected, if the concentrations as listed in Provision C.3., Appendix 2, Table 4 change as a result of changes in source-document conclusions or promulgation of drinking water standards, maximum contaminant levels or action levels.

COMPLETION DATE: 60 days after request made by the Executive Officer

OFFSITE OPERABLE UNIT

l. TASK 13: SOIL FLUX MONITORING WORKPLAN: Submit a technical report acceptable to the Executive Officer proposing sample locations and a sample schedule for long-term soil flux monitoring of chemicals of concern in the offsite area. The plan shall include sampling and analysis by EPA approved methodology. The schedule shall include seasonal (wet season/dry season) monitoring at locations as proposed and approved, with sampling to commence no later than September 15, 1991.
COMPLETION DATE: August 15, 1991

m. TASK 14: SOIL FLUX MONITORING: Submit a technical report acceptable to the Executive Officer including the results of the monitoring as proposed under Task 12 above. The report shall include results of analysis by EPA approved methodology, appropriately scaled maps, and evaluation of the results of the monitoring including comprehensive tabulations of all data collected and an episodic comparative evaluation of the health risk to residents of the offsite area. This report shall be submitted within forty-five (45) days of the completion of each scheduled sampling event as proposed and approved under Task 12. Following the fourth sample event from commencement of sampling (two years hence), the discharger may propose modification to the number of samples collected, sampling frequency or termination of the sampling program.

COMPLETION DATE: October 30, 1991 and every six months thereafter

n. TASK 14: MODIFICATION TO OFFSITE GROUNDWATER EXTRACTION SYSTEM: Submit a technical report acceptable to the Executive Officer proposing modifications to the offsite groundwater extraction system. This report shall include an evaluation of additional groundwater extraction, especially in the A zone to control migration of pollutants in the A zone. This evaluation may include locations and numbers of additional extraction wells or trenches and mechanical modifications to existing wells to improve system efficiency. Any proposed changes shall include an evaluation of increased groundwater extraction on the treatment system, water reuse, and water conservation. This report shall also include number and proposed location of any additional monitor wells required to improve system monitoring, especially to monitor migration north of the Bayshore Freeway.

COMPLETION DATE: September 15, 1991

o. TASK 15: IMPLEMENTATION OF MODIFICATION TO OFFSITE GROUNDWATER EXTRACTION SYSTEM: Submit a technical report acceptable to the Executive Officer documenting the completion of modifications to the offsite groundwater

extraction system. This report shall include well logs and locations for any new wells installed, specifications for modifications to pumps or pump placements, appropriately scaled location maps, and engineering drawings of systems modified as approved under Task 14 above.

COMPLETION DATE: September 15, 1992

p. TASK 16: OFFSITE WELL PUMPING CURTAILMENT CRITERIA AND PROPOSAL: Submit a technical report acceptable to the Executive Officer containing a proposal for curtailing pumping from offsite groundwater extraction well(s) and trench(s) and the criteria used to justify such curtailment. This report shall include data to show that cleanup standards for all VOCs have been achieved and have stabilized or are stabilizing, and that the potential for pollutant levels rising above cleanup standards is minimal. This report shall also include an evaluation of the potential for pollutants to migrate downwards to the C aquifer at this location. If the discharger claims that it is not technically feasible to achieve cleanup standards, the report shall evaluate the alternate standards that can be achieved. Cessation of pumping will require the concurrence of the Regional Board and EPA, should either party not concur, continued pumping will be required.

COMPLETION DATE: 90 days prior to proposed implementation of onsite groundwater extraction curtailment

q. TASK 17: IMPLEMENTATION OF OFFSITE CURTAILMENT: Submit a technical report acceptable to the Executive Officer documenting completion of the necessary tasks identified in the technical report submitted for Task 11. Cessation of pumping will require the concurrence of the Regional Board and EPA, should either party not concur, continued pumping will be required.

COMPLETION DATE; 30 days after the Regional Board approves onsite curtailment

r. TASK 18: FIVE-YEAR STATUS REPORT AND EFFECTIVENESS EVALUATION: Submit a technical report acceptable to the Executive Officer containing the results of any additional investigation including the soil remediation study; an evaluation of the effectiveness of installed final cleanup measures and cleanup costs; additional recommended measures to achieve final cleanup objectives and standards, if necessary; a comparison of previous expected costs with the costs incurred and projected costs necessary to achieve cleanup objectives and standards; and the tasks and time schedule necessary to implement any additional final cleanup measures.

This report shall also describe the reuse of extracted groundwater, evaluate and document the cleanup of polluted groundwater, and evaluate and document the removal and/or cleanup of polluted soil. If safe drinking water levels, through the removal of the chemicals for which this Order specifies cleanup standards, have not been achieved onsite and are not expected to be achieved through continued groundwater extraction and/or soil remediation, this report shall also contain an evaluation addressing whether it is technically feasible to achieve drinking-water quality onsite, and if so, a proposal for procedures to do so.

COMPLETION DATE: June 19, 1996

s. TASK 19: EVALUATION OF NEW HEALTH CRITERIA: Submit a technical report acceptable to the Executive Officer which contains an evaluation of how the final plan and cleanup standards for the Offsite OU would be affected, if the concentrations as listed in Provision C.3., Appendix 2, Table 4 change as a result of changes in source-document conclusions or promulgation of drinking water standards, maximum contaminant level goals, maximum contaminant levels or action levels.

COMPLETION DATE: 60 days after request made by the Executive Officer

3. All Technical reports submitted must be acceptable to the Executive Officer. The submittal of technical reports evaluating interim and final remedial measures shall include a projection of the cost, effectiveness, benefits, and impact on public health and the environment.

4. The remedial investigation and feasibility study shall consider the guidance provided by Subpart F of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300); Section 25356.1 (c) of the California Health and Safety Code; CERCLA guidance documents with reference to Remedial Investigation, Feasibility Studies, and Removal Actions; and the State Water Resources Control Board's Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California".

5. If the discharger is delayed, interrupted or prevented from meeting one or more of the completion dates specified in this Order, the discharger shall notify the Executive Officer prior to the deadline for the completion date.

6. Technical reports on compliance with the Prohibitions, Specifications, and Provisions of this Order, and progress on completion tasks as identified in the workplan as revised, shall be submitted on a quarterly basis, according to the schedule below, commencing with the report for the third quarter 1991, due October 31, 1991.

Quarter	1st quarter	2nd Quarter	3rd Quarter	4th Quarter
Period	Jan-March	April-June	July-Sept	Oct-Dec
Due Date	April 30	July 31	October 31	January 31

The quarterly reports shall include;

a. a summary of work completed since the previous quarterly report,
b. appropriately scaled and labeled maps showing the location of all monitoring wells, extraction wells, and existing structures,
c. updated water table and piezometric surface maps for all affected water bearing zones, and isoconcentration maps for key pollutants in all affected water bearing zones, shall be included at a minimum in the reports for the second and fourth quarters, or in the event of significant changes,
d. a summary tabulation of all well construction data, groundwater levels and chemical analysis results for all site monitor wells,
e. a summary tabulation of volume of extracted groundwater and chemical analysis for all site groundwater extraction wells,
f. an estimate of volume or mass of contaminants removed by each remedial system in the quarter and a cumulative tabulation of the total volume or mass of contaminants removed from the groundwater, (total and #/day)
g. identification of potential problems which will cause or threaten to cause noncompliance with this Order and what actions are being taken or planned to prevent these obstacles from resulting in noncompliance with this Order, and
h. in the event of noncompliance with the Provisions and Specifications of this Order, the report shall include written justification for noncompliance and proposed actions to achieve compliance.

7. All hydrogeological plans, specifications, reports, and documents shall be signed by or stamped with the seal of a registered geologist, engineering geologist or professional engineer.

8. All samples shall be analyzed by State certified laboratories or laboratories accepted by the Board using approved EPA methods for the type of analysis to be performed. All laboratories shall maintain Quality assurance/quality control records for Board review.

9. The discharger shall maintain in good working order, and operate, as efficiently as possible, any facility or control system installed to achieve compliance with the requirements of this Order.

10. Copies of all correspondence, reports, and documents pertaining to compliance with the Prohibitions, Specifications, and Provisions of this Order, shall be provided to the following agencies:

    a. Santa Clara Valley Water District
    b. Santa Clara County Health Department
    c. City of Sunnyvale
    d. State Department of Health Services/TSCD
    e. U. S. EPA Region IX (H-6-3)

    The Executive Officer may additionally require copies of correspondence, reports and documents pertaining to compliance with the Prohibitions, Specifications, and Provisions of this Order to be provided to the U.S. Environmental Protection Agency, Region IX, and to a local repository for public use.

11. The discharger shall permit the Board or its authorized representative, in accordance with Section 13267(c) of the California Water Code:

    a. Entry upon premises in which any pollution sources exist, or may potentially exist, or in which any required records are kept, which are relevant to this Order.

    b. Access to copy any records required to be kept under the terms and conditions of this Order.

    c. Inspection of any monitoring equipment or methodology implemented in response to this Order.

    d. Sampling of any groundwater or soil which is accessible, or may become accessible, as part of any investigation or remedial action program undertaken by the discharger.

12. The discharger shall file a report on any changes in site occupancy and ownership associated with the facility described in this Order.

13. If any hazardous substance is discharged in or on any waters of the state, or discharged and deposited where it is, or probably will be discharged in or on any waters of the state, the discharger shall report such discharge to this Regional Board, at (415) 464-1255 on weekdays during office hours from 8 a.m. to 5 p.m., and to the Office of Emergency Services at (800) 852-7550 during non-business hours. A written report shall be filed with the Regional Board within five (5) working days and shall contain information relative to: the nature of waste or pollutant, quantity involved, duration of incident, cause of spill, Spill Prevention, Control, and Countermeasure Plan (SPCC) in effect, if any, estimated size of affected area, nature of effect, corrective measures that have been taken or planned, and a schedule of these activities, and persons/agencies notified.

Signetics (cont.)

14. Order No. 89-058 is hereby rescinded.

15. The Board will review this Order periodically and may revise the requirements when necessary.

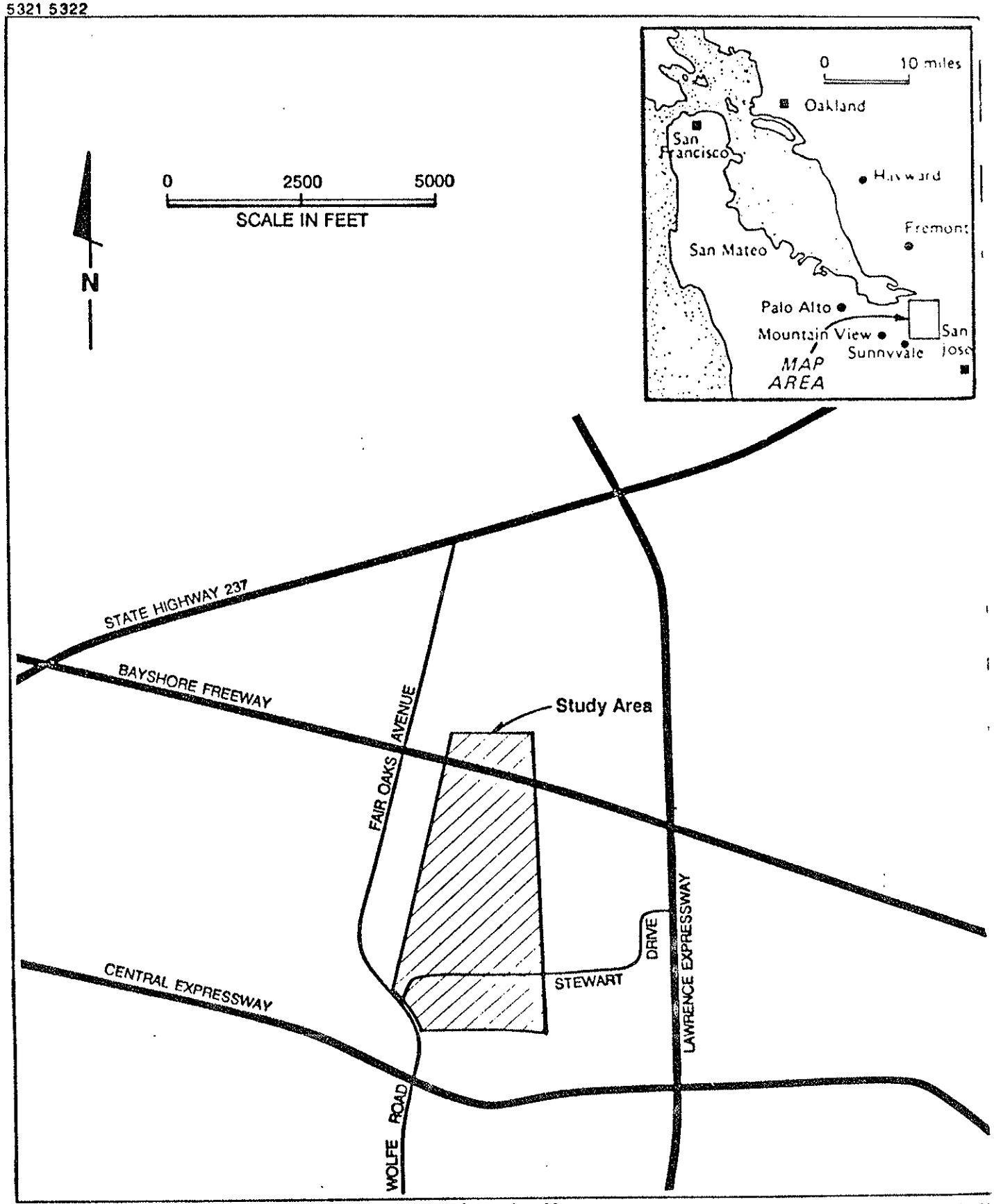
I, Steven R. Ritchie Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on June 19, 1991.

Steven R. Ritchie
Executive Officer

Attachments:
Appendix 1 - Figures (3)
Appendix 2 - Tables (4)

APPENDIX 1

5321 5322

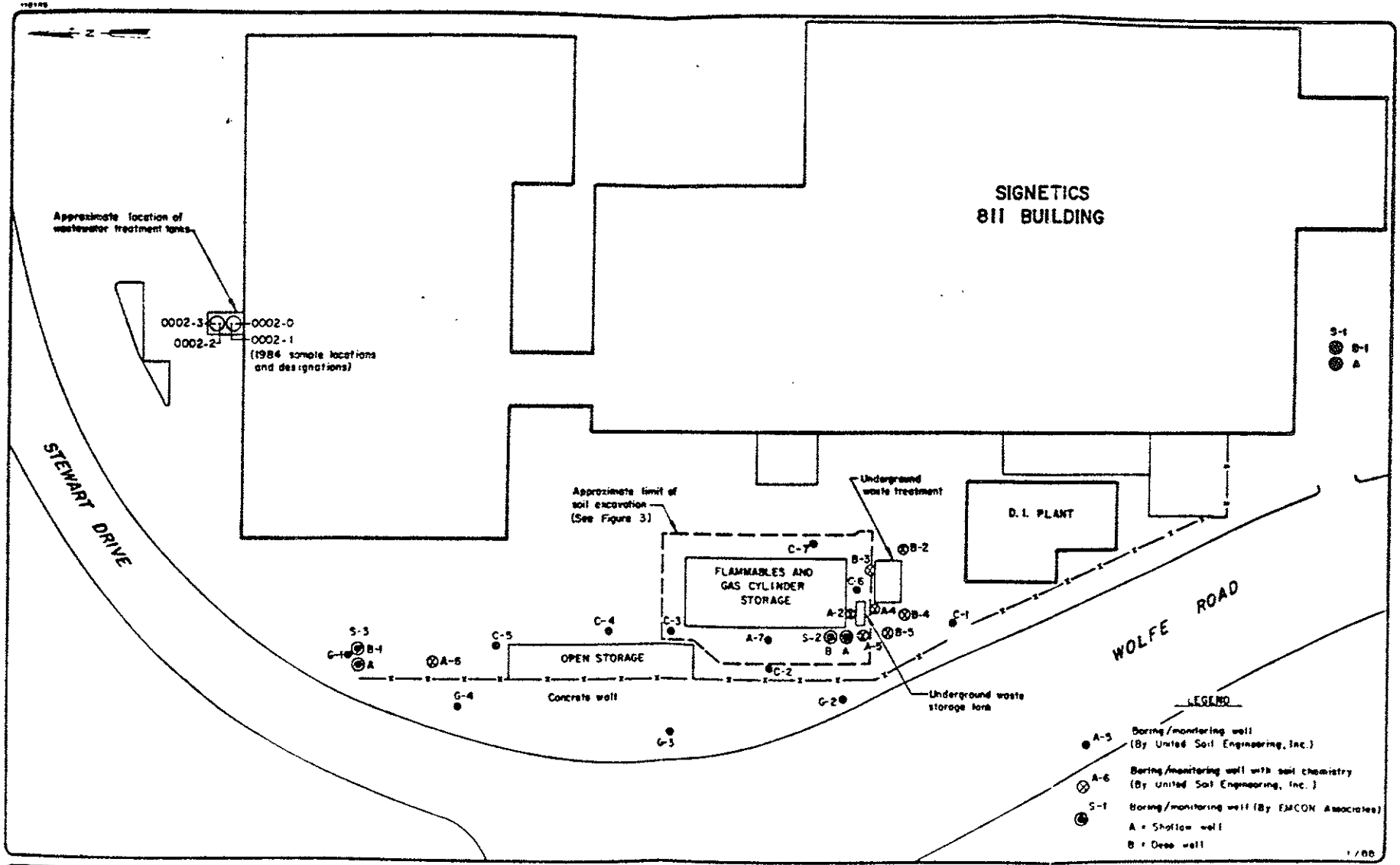


Harding Lawson Associates
Engineers and Geoscientists

Location Map
Feasibility Study
The Companies
Sunnyvale, California

PLATE **1**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
AM	17279,115.02	MF	1/91		



EMCON Associates

Scale: 0 50 100 150 200 Feet

SIGNETICS CORPORATION
HISTORICAL SOILS INVESTIGATION SUMMARY
811 EAST ARQUES AVENUE
SUNNYVALE, CALIFORNIA
WEST SIDE OF 811 ARQUES BUILDING UNITED SOIL ENGINEERING SAMPLES LOCATION MAP (1/82)

FIGURE 3

377-02 68

APPENDIX 2

Table 1. Chemicals of Concern In Groundwater

Compound	EPA CARCINOGEN CLASS[a]	APPLICABLE OPERABLE UNITS
1,2- Dichlorobenzene	D	AMD, TRW
1,1-Dichloroethane	B2	ALL
1,1-Dichloroethylene	C	ALL
cis-1,2-Dichloroethylene	D	ALL
trans-1,2-Dichloroethylene	D	ALL
Freon 113	NA	ALL
Tetrachloroethylene	B2	AMD, TRW, Offsite
1,1,1-Trichloroethane	D	ALL
Trichloroethylene	B2	ALL
Vinyl Chloride	A	AMD, TRW, Signetics

(a) EPA Carcinogenicity weight of evidence:

A = known human carcinogen
B1 = probable human carcinogen, limited evidence of carcinogenicity from human studies, but for which there is sufficient evidence of carcinogenicity from animal studies
B2 = probable human carcinogen, inadequate evidence of carcinogenicity from human studies, but for which there is sufficient evidence of carcinogenicity from animal studies
C = possible human carcinogen, limited evidence of carcinogenicity from animal studies
D = not classified as to human carcinogenicity, inadequate human and animal evidence of carcinogenicity or for which no data are available
E = evidence of non-carcinogenicity in humans, no evidence of carcinogenicity in adequate human or animal studies

Table 2 – Evaluation of Remedial Action Alternatives for the Signetics Operable Unit

Alternative	Protection of Human Health and Environment (1)	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-term Effectiveness (2)	Implementability	Cost (Present Value) (3)
1 No action (No further remedial action; continue monitoring)	Not Protective	Not for hundreds of years	Not effective	No active reduction of T,M or V	Potential risk to community through continued VOC migration; GCT is more than 100 years	Implementable	$1.5 million
2 No additional groundwater or vacuum extraction	Less Protective CR = 4E-5 HI = 0.08	Yes	Allows VOCs to migrate offsite	Reduction of T,M and V	Negligible risk; GCT,A = 13/18 years GCT,B = 36/51 years	Easily Implementable	$3.9/$4.4 million
3 Enhanced Groundwater Extraction (A- & B-Aquifers)	Protective CR = 4E-5 HI = 0.08	Yes	Effective	Reduction of T,M and V	Negligible risk; GCT,A = 8/11 years GCT,B = 24/34 years	Implementable	$3.9+/$4.5 million
4 Enhanced Groundwater (A- & B-Aquifers) and Vacuum Extraction (A-Aquifer)	Protective CR = 4E-5 HI = 0.08	Yes	Effective; accelerates hot spot remediation	Reduction of T,M and V	Negligible risk; GCT,A = 8/11 years GCT,B = 24/34 years	Implementable	$4.1/$4.7 million

Note: The preferred alternative is shaded.

(1) CR = Carcinogenic risk for domestic use of groundwater from combined A/B-aquifers; calculations include 1,1-dichloroethene and are for the average scenario.

(2) GCT,A = Groundwater cleanup times for the A-aquifer; years to clean up to remedial goals and to background. GCT,B = Groundwater cleanup times for the B-aquifer; years to clean up to remedial goals and to background.

(3) Costs given for cleanup to remedial goals (first cost) and to background (second cost).

(4) Existing treatment system consists of air stripping of extracted groundwater, followed by carbon treatment of the effluent (water and offgas).

Table 3 – Evaluation of Remedial Action Alternatives for the Offsite Operable Unit

Alternative	Protection of Human Health and Environment (1)	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-term Effectiveness (2)	Implementability	Cost (Present Value) (3)
1 No Action	Not protective	Not for hundreds of years	Not effective	No reduction of T, M, V	Not effective	Implementable	$1.9 million
2 Expanded extraction; use of current treatment system (4)	Protective CR = 4E-5 HI = 0.2	Yes	Effective	Reduction of T, M, V	Effective GCT,A = 21/30 years GCT,B = 36/53 years	Implementable	$4.4/$4.9 million
3 Expanded extraction; treatment by carbon adsorption only	Protective CR = 4E-5 HI = 0.2	Yes	Effective	Reduction of T, M, V	Effective GCT,A = 21/30 years GCT,B = 36/53 years	Implementable	$10/$11 million

Note: The preferred alternative is shaded.

(1) CR = Carcinogenic risk for domestic use of groundwater from combined A/B-aquifers; calculations include 1,1-dichloroethene and are for the average scenario.

(2) GCT,A = Groundwater cleanup times for the A-aquifer; years to clean up to remedial goals and to background.
GCT,B = Groundwater cleanup times for the B-aquifer; years to clean up to remedial goals and to background.

(3) Costs given for cleanup to remedial goals (first cost) and to background (second cost).

(4) Existing treatment system consists of air stripping of extracted groundwater, followed by carbon treatment of the water.

TABLE 4
Cleanup Standards for the Chemicals of Concern In Groundwater

SIGNETICS, 811 E. ARQUES
Sunnyvale, California

COMPOUND	FEDERAL MCLG[a]	FEDERAL MCL[b]	CALIFORNIA MCL	APPLICABLE OPERABLE UNITS
1,2- Dichlorobenzene	(600)	(600)	NA	AMD, TRW
1,1-Dichloroethane[c]	NA	NA	5	ALL
1,1-Dichloroethene[d]	7	7	6	ALL
cis-1,2-Dichloroethene	(70)	(70)	6	ALL
trans-1,2-Dichloro-ethene	(100)	(100)	10	ALL
Freon 113	NA	NA	1,200	ALL
Tetrachloroethene[c]	(0)	(5)	5	AMD, TRW, OFFSITE
1,1,1-Trichloroethane	200	200	200	ALL
Trichloroethene[c]	0	5	5	ALL
Vinyl Chloride[c]	0	2	0.5	AMD, TRW, Signetics

(a) MCLG = maximum contaminant level goal. Concentrations in micrograms per liter.
(b) MCL = maximum contaminant level. Concentrations in micrograms per liter.
(c) Potential or probable human carcinogen.
(d) Possible human carcinogen.
NA = Not available.
( ) Criteria in parentheses are proposed standards